



## Using residents' perceptions to improve park-people relationships in Chatthin Wildlife Sanctuary, Myanmar

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### ABSTRACT

The complex and context-specific relationships that local residents have with neighboring protected areas present many challenges for protected area (PA) management. While long-term, interdisciplinary approaches may be necessary to fully understand park-people relationships within a particular PA, the reality is that management decisions for the majority of PAs in the world are made by protected area staff with little or no external assistance. One potential entry point for management to understand park-people relationships and improve management is through understanding people's perceptions of PAs. This paper presents a study from Chatthin Wildlife Sanctuary in central Myanmar designed to explore the impact of using residents' attitudes to directly inform management strategies. We conducted a survey to determine attitudes and determinants of attitudes toward CWS. In response to the survey, the warden made changes to the Sanctuary's management strategy to accommodate local needs and perceptions. Four years later, we repeated the survey to explore the effects of the management changes on people's perceptions and found that people were significantly more likely to like the sanctuary, less likely to mention problems, and more likely to mention benefits. People's negative perceptions of management conflicts and crop damage decreased and their positive perceptions of conservation and ecosystem service benefits and extraction benefits increased. This study demonstrates that residents' perceptions can be used by management as a starting point to improve park-people relationships through feasible and targeted interventions that are meaningful to local communities and their relationships with PAs.

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### 1. Introduction

Local residents in developing countries are critical to the long-term, sustainable conservation of biodiversity within protected areas (Dasmann, 1984; Machlis and Tichnell, 1985; Brandon and Wells, 1992; Newmark et al., 1993; Fiallo and Jacobson, 1995; Furze et al., 1996). The relationships that local residents have with their neighboring protected areas (PAs) are complex and context-specific (Dearden et al., 2005). While it can be argued that long-term, interdisciplinary approaches may be necessary to fully understand the park-people relationship within a particular PA (West and Brockington, 2006), the reality is that management decisions for the majority of PAs in the world are being made and

will continue to be made by protected area staff without the luxury of teams of scientists or other external assistance.

One potential entry point for management to understand park-people relationships is through understanding people's perceptions of PAs. Local residents' perceptions of protected areas are not only a foundational component of park-people relationships (Lynam et al., 2007), they are also a key indicator of protected area success (Struhsaker et al., 2005). Understanding the park-people relationship from residents' perspectives can provide guidance for policy and management decisions (Parry and Campbell, 1992; Hill, 1998; Weladji et al., 2003) and a baseline for assessing success of management activities (Gillingham and Lee, 1999; Weladji et al., 2003). Understanding resident perceptions can also provide a foundation upon which management can begin a process of interaction with local communities by identifying potential entry points to constructively engage with local residents and helping managers understand how they are perceived by residents. The relationship between management and local residents can strongly influence residents' attitude toward PAs (Parry and Campbell,

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1992; Newmark et al., 1993; Fiallo and Jacobson, 1995; Ite, 1996; Alexander, 2000; Infield and Namara, 2001; Holmes, 2003; Picard, 2003; Allendorf et al., 2007). Positive interactions between management and residents can increase local acceptance of protected areas (Mannigel, 2008), while residents' distrust of management can contribute to local opposition to protected areas (Stern, 2008).

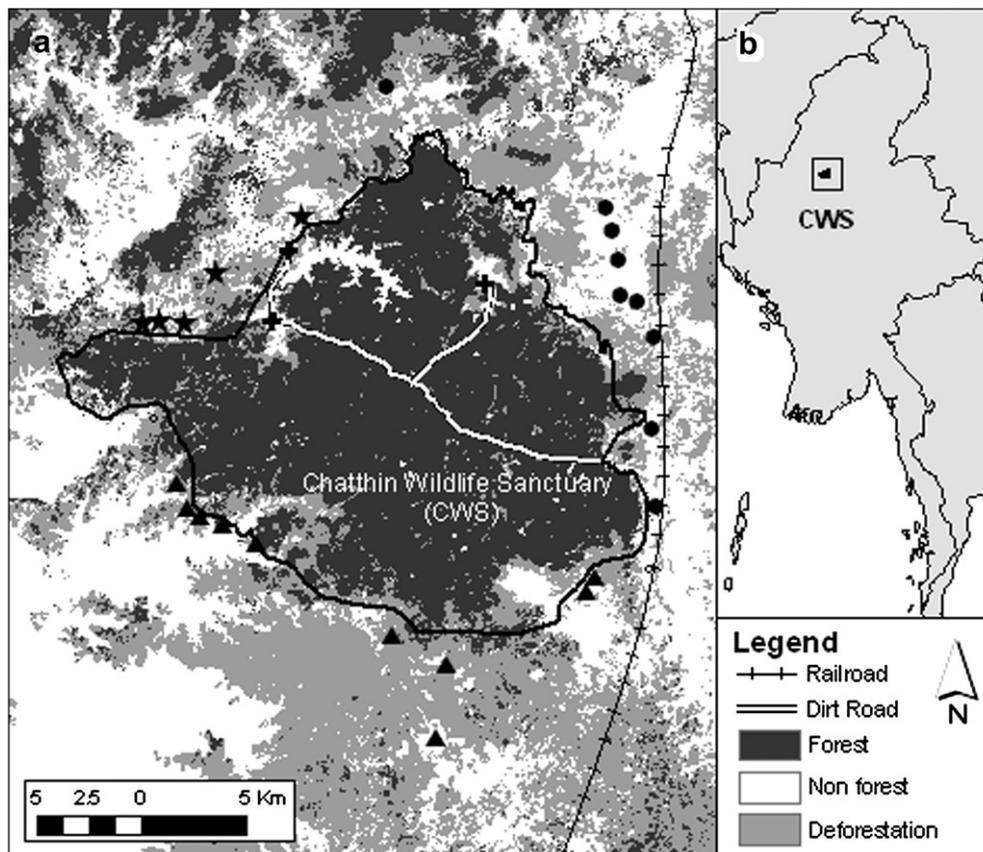
The need for management to engage directly with local residents is especially important in countries where there is little support from central government for protected areas and very limited outside aid for biodiversity conservation. At a global level, it is estimated that 42% of protected areas have major management deficiencies and 13% are very inadequate, with community involvement and programs being weak in the majority of cases although they are strongly correlated with both overall effectiveness and good management outcomes (Leverington et al., 2010). In order to promote more effective conservation of protected areas, tools and approaches are needed that facilitate management's ability to undertake activities that improve park-people relationships.

This study was designed to explore the impact of using residents' attitudes to directly inform management strategies. As far as we aware, while previous studies have demonstrated that management actions can affect residents' attitudes, this is the first study to attempt to quantitatively demonstrate a change in attitude due to targeted management activities. We wanted to use an approach that minimized the role of outside experts and gathered information that could be analyzed and interpreted by management to design feasible and targeted interventions that are meaningful to local communities and their relationships with PAs.

The study was conducted around Chatthin Wildlife Sanctuary (CWS) in central Myanmar (Fig. 1). Myanmar is an example of a country that lacks support for its protected areas. Over a third of the protected areas in Myanmar are "paper parks" and only 2.1% of the area in protected areas could be considered part of an "effective PA system" (Aung, 2007). No protected area in Myanmar has the infrastructure or staff to manage the area effectively (Rao et al., 2002).

## 2. Study area

Myanmar is not only one of the most biologically diverse regions in Asia (Myers et al., 2000; Wikramanayake et al., 2001) but, in contrast to many other nations in Southeast Asia, large tracts of its natural habitats still exist (Leimgruber et al., 2003). In 1990, Myanmar had more than half of the remaining forests in mainland Southeast Asia (Dinerstein and Wikramanayake, 1993), and they represent some of the last strongholds for large mammals such as tigers and elephants (Leimgruber et al., 2003; Lynam, 2003). However, Myanmar's growing human populations have increased pressure on its natural resources and PAs, and resources are increasingly strained by demands from Myanmar's neighbors – China, India, Thailand, and Bangladesh (Aung, 2007). Many threats to PAs in Myanmar come from small-scale activities of local communities (Rao et al., 2002), such as deforestation (Leimgruber et al., 2005), hunting (Rao et al., 2002; Lynam, 2003), and agricultural practices (Leimgruber et al., 2005; Aung, 2007). These activities have caused significant declines in wildlife populations and loss of natural habitats. There have been few to no environmental education activities or conservation and development activities



**Fig. 1.** (a) Chatthin Wildlife Sanctuary (CWS) and surrounding villages; background based on land cover change analysis comparing satellite imagery from 1973 to 2005 (see also Songer et al. 2009); (b) location of CWS in Myanmar. Crosses represent villages inside CWS, circles represent villages in the east zone, triangles represent villages in the south zone, and stars represent villages in the west zone.

around Myanmar's PAs, and as in many developing countries, Myanmar's PA managers have neither the human capacity nor technical and financial resources to effectively manage the areas (Rao et al., 2002; Aung, 2007).

Chatthin Wildlife Sanctuary (CWS) is a fragment of second growth monsoonal forest known as *indaing* (Aung et al., 2004) and is the largest remaining habitat of the endangered thamin or Eld's deer (Koy et al., 2005). This deciduous dipterocarp habitat was once dominant in the arid central plains between the Shan plateau and the Chin Hills. CWS has 223 bird species, four of which are endemic (Nay Myo Shwe, personal communication); 26 mammal species, including hog deer, muntjac, macaque, and wild dog, in addition to thamin (Aung et al., 2004); 16 amphibian and 34 reptile species (Zug et al., 1998); and 21 fish species (Myint Aung, personal communication). Twenty-five villages surround the border of CWS and three villages are located inside the sanctuary's borders (Fig. 1). Thirteen villages were relocated from inside the sanctuary to areas farther away in the mid-1990's. The remaining three villages still inside the sanctuary were scheduled for resettlement in 1996, but to date resettlement has not occurred (Aung et al., 2004). CWS is the primary source of forest products for local communities.

The majority of residents around CWS are of Burman origin. Demographic surveys show that CWS villages have increased in population size since the first census in 1989 (Aung et al., 2004). Between 1989 and 2004, there was a 62% increase in the population of the area; in 2004, the average village size was 853 individuals with villages ranging from 150 to 3820 individuals (Songer, 2006).

Rice is the primary food crop of farmers living in and around the sanctuary. Non-rice crops include maize, sugarcane, and several varieties of groundnuts, which are planted as a source of cooking oil. In the northeastern region of CWS, sugarcane cultivation is common. Households supplement their diets and on occasion their incomes by planting fruit trees and other plants such as bananas, mango, papaya, tamarind, coconut, vegetables, chili, and assorted medicinal plants. Domestic livestock include cattle, water buffaloes, goats, pigs, chickens, and ducks.

Prior to this research, residents were not allowed to extract any resources from the PA and illegal use of the sanctuary was common. Of the 113 offenses that sanctuary staff registered between 1993 and 2000, logging and processing timber within the sanctuary accounted for 72% of the offenses, while poaching game and fish accounted for 11% of the offenses; encroachment in the sanctuary accounted for 9% of the offenses (Aung et al., 2004). It should be noted that these offenses were the ones that staff registered, and does not account for all illegal activities in CWS, such as extraction of fuelwood and food. The majority of people in the villages surrounding CWS collect fuelwood from CWS, yet between 1993 and 2000, fuelwood extraction accounted for less than 5% of the registered offenses (Aung et al., 2004). Low impact offenses, such as harvesting mushrooms, were rarely if ever registered. For a detailed history of CWS, see Aung et al. (2004).

Over the past two decades, the primary threats to CWS have been economic and land use decisions, such as a series of government-planned economic enterprises that incited the regional authorities to dispute the legal right of the Forestry Department to CWS and caused encroachment by people who felt that CWS was open for settlement. For a more detailed description of past and current threats to CWS, please see Aung et al. (2004).

In late 1994, the Smithsonian Institution selected CWS for a multi-year ecological study of the thamin, and initiated training courses in ecology and biodiversity inventory methods for PA staff. Over the next eight years, 25 specialists conducted nine training courses for staff of CWS and other protected areas. While the sanctuary was gazetted in 1941, it wasn't until 1996, in conjunction with a thamin conservation project sponsored by the Smithsonian

Institution, that guards began regular patrolling of the sanctuary. With Smithsonian support, 32 staff were assigned to patrol the sanctuary border. At this same time, a Myanmar environmental educator and a small team of CWS staff visited schools and discussed conservation of the deer. CWS staff have initiated some community projects in the town of Chatthin, on the east side of CWS, such as a clean-up campaign that provided trash barrels and signs about keeping the town clean. Otherwise, there were no environmental education projects prior to the first 1999 survey.

### 3. Methods

In 1999 and 2003, we conducted standardized open-ended surveys (Patton, 1990) of both men and women over 18 years old to determine attitudes and determinants of attitudes toward CWS. We define attitude, using attitude theory (Ajzen and Fishbein, 1980), as a human psychological tendency expressed by evaluating a particular object with favor or disfavor. In this case, attitude is overall like or dislike of the PA. Attitude consists of beliefs, which are associations people establish between the attitude object and various attributes. For example, in the phrase, 'a national park is part of a country's wealth,' 'national park' is the attitude object, 'country's wealth' is an attribute, and 'is part' is a relational term. We generated a list of beliefs, or perceptions, about PAs by asking people why they liked or disliked the area and the benefits and problems the area caused for them. To facilitate analysis of the data, people's perceptions of benefits and problems and reasons for liking or disliking the areas were sorted into major categories. The categories were created inductively after consideration of the responses gathered in the survey. In addition, we collected five socioeconomic variables: gender, age, education, landholding, and family size.

For the 1999 survey, the first author trained three local school teachers in survey methods in the fall of 1999. Training included survey design, writing survey questions, random sampling and data compilation. After the training, we jointly designed an attitude survey protocol, conducted trial surveys and created data ledgers and a computerized database. We selected local school teachers to conduct the survey because school teachers are highly respected in Myanmar and are easily accepted into the communities. They are also familiar with the area and able to travel and conduct interviews freely. While there is a danger that respondents might want to give the 'right' answers to the teachers as respected authority figures, it is difficult to predict in this case what the 'right' answers might be. In order to minimize bias, we asked open-ended questions. The teachers did not have a previous relationship with the respondents in the context of CWS, nor had these teachers previously participated in environmental education activities with the communities.

In 1999, we conducted a total of 862 interviews in 28 villages at CWS. We randomly selected 30 households from ledgers in each village maintained by village chairmen. In villages with fewer than 30 households, we interviewed someone at each household. Only people over 18 years old were interviewed. To assure representation of the perspectives of different residents, we developed a sampling method that included age, gender and household position. At the first house in a village the husband was interviewed, the wife at the second, the grandfather at the third, the grandmother at the fourth, the eldest child 18 years or older at the fifth, and the youngest child 18 years or older at the sixth. If the appropriate person was not available, we proceeded through the sequence. The refusal rate was extremely low, only a handful in each area, usually because a person did not have the time to participate.

Interviewers introduced themselves to respondents by explaining they were local school teachers conducting a survey at the PA warden's request. While this might have biased people's responses, we felt it was important for the future relationship between the communities and PA management to be honest with respondents about the relationship between the school teachers and the PA management. It was also impossible to predict which way people's responses might be biased; people might have been more negative about issues in order to push for changes from PA management or more positive because they wanted to please the teachers or the PA management. There is anecdotal evidence that if people perceive a close association with the PA management, they are more negative. Public meetings held in Alaungdaw Kathapa National Park and Htamanthi Wildlife Sanctuary in 2003 indicated that residents were more likely to openly air complaints if PA staff were present in group meetings (Eberhardt, 2003).

After introducing themselves, the teachers asked the survey questions beginning with the five socioeconomic questions. They then recorded verbatim responses to the questions, 'What are the problems the protected area causes you?' and 'What are the benefits of the protected area?' Finally, respondents were asked if they liked or disliked the PA and why.

During the summer of 2003, the survey was conducted by two of the same teachers who conducted the survey in 1999. Interviews with 784 residents were conducted by randomly selecting households from lists provided by village chairmen from 28 villages in and around CWS using stratified-random sampling by age and gender. The survey was part of a project conducted by the last author to understand resource requirements and uses in local communities adjacent to remaining tropical dry forests. Therefore, the 2003 survey, in addition to the questions concerning attitude and perceptions described above, included additional questions concerning information about agricultural practices, use of forest products by the household, and household assets.

At the suggestion of the warden of CWS at the time, the second author of this paper, we analyzed the data based on geographical zones around the sanctuary. We divided the area into western ( $n = 5$  villages), eastern ( $n = 9$  villages), southern ( $n = 11$  villages), and inside ( $n = 3$  villages) zones. At the time of the first survey, the warden had worked in CWS for five years, four of them as warden. Based on his knowledge of the differences in communities' status and relationships with the sanctuary and its staff, he felt that there were meaningful differences among these zones that could help inform management strategies.

#### 4. Changes in management strategy

Between 1999 and 2003 management strategies were adapted based on results from the 1999 survey. Using the geographical zones, we were able to break the 1999 attitude survey results down into manageable pieces that allowed management to target their activities and focus on areas with the most negative attitudes. While some strategies adopted were applied across all communities, other strategies were targeted at specific geographic zones and tailored to their situation. We assessed success of the changes in management strategies by comparing the results of attitude surveys conducted in 1999 to results of the 2003 survey.

Based on the results of the initial survey, the warden made changes to the CWS management strategy to accommodate local needs and perceptions (Table 1). These changes were based on the premise that people's attitudes could be improved by building on positive perceptions that they already held and mitigating negative perceptions where possible.

First, the warden began to hold annual meetings with leaders from the surrounding communities in order to have a formal

**Table 1**  
Management actions implemented by geographic zone.

	West	East	South	Inside
Annual meeting with community chairmen	✓	✓	✓	✓
Informal individual extraction of fuelwood and NTFPs	✓	✓	✓	✓
Formal community extraction of timber	✓	✓	✓	✓
Environmental education	✓		✓	✓
Road access	✓			
Buffer zone creation			✓	

mechanism for interacting with them and discussing issues concerning the park. Second, he organized a group of 5–6 staff to conduct environmental educational programs in communities, primarily in the west and south zones, but also with some activities in the inside zone. The goals of these activities were twofold: to increase the positive interactions that residents had with CWS staff and increase residents' understanding of the environmental benefits of CWS, such as ecosystem services.

Third, he allowed extraction of some resources at the community and individual level. If they first asked for permission, communities were allowed to cut logs for building or repairing bridges, monasteries, and schools and they could borrow the CWS generator to cut the timber. In return, they would pay for the fuel and provide room and board for a CWS staff member who would stay with them to oversee the work. On occasion, the staff would give communities timber for building schools that they had confiscated from individuals that were illegally extracting. On an informal basis, individuals were allowed to extract dry and fallen wood for fuelwood and certain non-timber forest products (NTFPs), such as fodder, thatch, mushrooms, leaves for packing, bamboo shoot, and sand, in order to make cement to build houses. Staff also informally allowed poorer residents to extract certain resources, such as smaller pieces of wood to build storage containers for rice.

Fourth, he gave people on the west side access to the road through the sanctuary if they asked for permission, which was the most direct way to the main town in the area and the railway. Up to that point, CWS policy had not allowed people to travel through the sanctuary because people would illegally extract fuelwood and other resources.

Fifth, he created a buffer zone between the sanctuary and the communities on the south side where most of the crop damage by deer was occurring. The Eld's deer, the primary species protected in CWS, tended to spend most of their time in the southern half of the sanctuary and would frequently cross over into agriculture fields on the southern side to eat the crops. Once the area became buffer zone, it fell under the jurisdiction of the warden rather than the Forest Department, and he initiated management activities in the area, such as replanting of tree species of interest to the local communities. The regeneration of the buffer zone meant they went less frequently inside the sanctuary and it also provided better habitat for deer.

No specific additional activities were undertaken in the eastern or inside zones. In the eastern zone the warden already had a relatively close relationship with the communities as they were nearest to the field headquarters and many of the staff had homes and family in the area. In the inside zone, management already had frequent interactions with residents since they were inside the sanctuary and, even prior to the first survey, they were allowed limited extraction of NTFPs and timber since they had no land adjacent that was not sanctuary from which they could extract.

#### 5. Results

We tested for differences between the 1999 and 2003 surveys using chi-square tests with a threshold of  $p < 0.05$  for significance

(Table 2). Only significant results, unless noted, are discussed. Compared to 1999, in 2003, more people liked CWS (43% vs 55%), more mentioned benefits from the sanctuary (44% vs 59%), and fewer mentioned problems (74% vs 66%). People's perceptions of management conflicts (38% vs 32%) and crop damage (14% vs 9%) decreased significantly and their perceptions of conservation and ecosystem service benefits (36% vs 47%) and extraction benefits (7% vs 25%) increased significantly.

Breaking down people's attitudes by zone, more people in the three zones where the majority of management changes took place (west, south, and inside) liked the area in 2003 than in 1999 and were more likely see benefits. In two of the zones (south and inside) people were also less likely to see problems. More people in all zones perceived more extraction benefits, with the exception of the inside zone where a large percentage already recognized extraction benefits in 1999. Conservation benefits were perceived by significantly more people in the west and inside zones, whereas in 1999 people in these zones had perceived these benefits the least. In the southern zone, perceptions of problems with wildlife decreased and management benefits increased. In the inside zone, fewer people perceived extraction problems and more perceived wildlife problems.

In the eastern zone, where management changed the least, perceptions of management problems and benefits went down significantly. The decrease in management problems is accounted for by fewer people mentioning the reclaiming of encroached land within the protected area by PA management.

## 6. Discussion

In CWS, the warden and staff were able to improve attitudes toward the sanctuary by building on positive perceptions that residents already held and mitigating negative perceptions, demonstrating that an understanding of local residents' perceptions can help PA management improve the PA-people relationship by giving them information to design and implement feasible and targeted interventions that are meaningful to local communities and their relationships with PAs.

In all zones where environmental education activities were undertaken (western, southern, and inside zones), we found increased perceptions of conservation and ecosystem service benefits. The increase was particularly large in the western and inside zones, the most isolated communities, and was correlated with the biggest gains in the number of people reporting that they

liked the sanctuary. This finding supports the idea that non-utilitarian values are relevant to local communities and have an important role to play in park-people relationships (Norton, 1989; Infield and Namara, 2001; Kuriyan, 2002; Allendorf, 2007). A perception of conservation and ecosystem benefits has been found to be the key predictor of a positive attitude across protected areas in Myanmar and Nepal (Allendorf et al., 2006; Allendorf, 2007).

In the southern zone, the creation of the buffer zone was associated with a significant increase in people's perception of management benefits and a significant decrease in a perception of wildlife problems, indicating that buffer zone achieved its goals: to provide resources for people and provide a buffer between the human population and the deer population. When the area became buffer zone, it fell under the jurisdiction of the warden rather than the Forest Department, and he was able to initiate management activities in the area, such as replanting of tree and plant species of interest to the local communities that keep them from going as close to the sanctuary border and provide better habitat for deer. After the period of the study, community forestry projects were established in eight communities around the sanctuary, primarily in the buffer zone forest, and these forests are in the process of being legally registered. Interestingly, while the perception of wildlife problems decreased in the southern zone, it increased in the inside zone, which lies to the north of the core habitat. This may be because of the overall increase in the thamin population in the sanctuary (discussed below). If the buffer zone had not been created, the southern villages may have also seen an increase in problems with wildlife.

In the eastern zone, where few actions were taken, attitude and perceptions changed the least. The main change was that fewer residents perceived management problems or benefits. The decrease in the perception of management problems was due to a decrease in the number of people who mentioned management's reclaiming of land that residents had encroached upon inside the sanctuary as a problem. This may have been due to the fading of grievances over time.

It is possible that the warden's rapport with local people during this time is responsible for much of the improvement in attitudes because people's perceptions toward protected areas are influenced by their relationship with management (Parry and Campbell, 1992; Newmark et al., 1993; Fiallo and Jacobson, 1995; Ite, 1996; Alexander, 2000; Infield and Namara, 2001; Holmes, 2003; Picard, 2003; Allendorf et al., 2007). However, he had already been warden for four years prior to the initial survey and the fact that attitudes

**Table 2**  
Percent of respondents reporting benefits and problems by survey wave and zone with *p*-values from chi-square tests by zone.

(N)	All zones			West			East			South			Inside		
	1999 (840)	2003 (784)	<i>p</i> -value	1999 (151)	2003 (140)	<i>p</i> -value	1999 (275)	2003 (252)	<i>p</i> -value	1999 (317)	2003 (308)	<i>p</i> -value	1999 (97)	2003 (84)	<i>p</i> -value
Like	43	55	0.00	27	56	0.00	49	46	0.44	41	53	0.00	60	87	0.00
Mentioned at least one problem	74	66	0.00	58	61	0.58	81	77	0.25	75	64	0.00	68	42	0.01
Mentioned at least one benefit	44	59	0.00	28	61	0.00	52	52	0.86	39	56	0.00	63	82	0.00
Problems															
Extraction	51	50	0.66	46	46	1.00	64	67	0.47	41	46	0.20	56	20	0.00
Management	38	32	0.01	38	39	0.89	43	31	0.00	37	31	0.11	30	27	0.71
Crop damage	14	9	0.00	1	1	0.52	8	9	0.64	29	11	0.00	6	15	0.04
Benefits															
Conservation & ecosystem services	36	47	0.00	19	49	0.00	45	45	0.97	37	41	0.35	34	68	0.00
Resource extraction	7	25	0.00	3	25	0.00	7	13	0.02	2	31	0.00	32	35	0.72
Management	6	6	0.94	6	2	0.10	9	2	0.00	2	10	0.00	9	5	0.24
For country	4	5	0.08	5	6	0.68	7	8	0.54	1	3	0.09	1	5	0.13

changed depending on the zone, and were clearly correlated with specific management actions, indicates that it is the management strategies themselves that account for much of the change. In the zone with no new management actions, attitudes did not change. Also, the warden himself did not greatly change his personal interactions with communities between the time two years prior to this study, when he started meeting with village headman, and during the period of the study. However, his understanding of their relationships with the protected areas would have improved during this time because of the study, making him more effective at communicating with village headmen.

Along with conservation and ecosystem service benefits, extraction benefits appear to have played an important role in improving attitudes. Extraction benefits were mentioned significantly more in all the areas, except the inside zone where the warden had already allowed limited extraction since 1998. Other studies have also found that extraction is correlated with more positive attitudes (Baral and Heinen, 2007). However, it should be noted that in the eastern zone, the perception of extraction benefits increased but the numbers of people who reported liking the sanctuary did not increase. Extraction is a key issue because people's day-to-day needs are often met through resource extraction from PAs, which are relatively well-protected, whereas public land outside PAs is often degraded with few useful resources, as in the case of CWS (Songer, 2006).

While perceptions of extraction benefits increased, the perceptions of extraction problems did not decrease. They remained the same or increased in all zones except the inside zone. This may be because the majority of the extraction was informally allowed, so the policy against in extraction was still in place, leaving people to continue to dislike or even resent that they could not officially extract. For example, the sanctuary guards still confronted people they found extracting resources, even in cases where the extraction was ultimately permitted. It could also be that although residents could extract more than before, it was still not sufficient to meet people's needs, so their perception of extraction problems remains the same even while perceived benefits increase.

While the approach we used in CWS may be considered a success in terms of engaging with local people and improving their attitudes, it is also important to consider if the easing of the extraction rules was detrimental to the conservation of CWS. Looking at changes in household consumption, deforestation rates, and the thamin population during this time, it appears that household extraction and overall deforestation decreased during this time period and the primary species of conservation interest, the thamin, increased. In order to understand whether household consumption of sanctuary resources changed over this period, we compared unpublished data from a resource use survey collected in 1999 by the park staff to data collected on resource use as part of the 2003 survey. The data shows that the percentage of households who reported extracting fuelwood and housepoles and the number grazing their livestock in the sanctuary declined between 1999 and 2003 (Table 3). The number of carts of fuelwood used per household also decreased during this time. This indicates that although extraction regulations were loosened, household extraction of resources from the sanctuary decreased.

Unfortunately, this does not mean that overall fewer resources were extracted. During this time the total number of households increased because of the resettlement of the villages along the southwestern edge due to the dam construction. The decrease in resource extraction may indicate that resources within the sanctuary were becoming increasingly degraded, particularly on the edge, and so people either cut back on their use or substituted. However, in terms of the warden trying to improve the park-people relationship and keep extraction in check, the informal easing of

extraction rules for NTFPs does not appear to be associated with an increase in resource extraction at the household level.

Analysis of a time-series of satellite images provides periodic estimates of deforestation rates inside and outside CWS between 1973 and 2005 (Songer et al., 2009). Although acquisition dates do not line up exactly with interview survey dates, we found that deforestation rates occurring inside CWS from 1992 to 2001 were higher than those found from 2001 to 2005. While this does not address the quality of the understory and possible increased extraction of non-timber forest products, it does indicate that timber extraction did not increase after the survey when it was allowed under certain conditions versus prior to our survey when timber extraction only occurred illegally.

In terms of the species of primary conservation interest in the sanctuary, the thamin, the levels of extraction between 1999 and 2003 do not seem to have negatively impacted their population. With regular patrolling of the sanctuary beginning in 1996, as part of the Smithsonian project described in section 2, the population of thamin began to increase. Annual monitoring of the deer population by sanctuary staff shows that the increase is steady from 1996 through the period of this survey (Fig. 2). The population continued to increase until 2004, when a new warden was assigned to the Sanctuary. The decline in the deer population at this time can be attributed to the change in management strategy by the new warden, who did not prioritize sending support to the Sanctuary for patrolling and monitoring, instead using funds to support staff and activities at the Sanctuary headquarters in the town of Kanbalu. At the same time staffing levels decreased. Thus, there were both fewer staff based at the sanctuary and fewer funds committed to supporting them. While part of the decline was due to poaching of thamin by local residents, either for meat or for the Chinese market, increased human use could also impact the thamin (William McShea, personal communication). Thamin young are susceptible to predation by dogs and increased use of the reserve by humans with dogs would increase fawn mortality. Increased human activity would also shift deer away from water sources during dry seasons, potentially reducing their survival.

One of the most important outcomes of the survey was that it provided a way for sanctuary staff to engage with local residents and vice versa. Residents responded positively to the idea that the sanctuary management was interested in their perceptions. As one respondent remarked while participating in the survey, "We like these questions. No one has ever asked us our opinion about the park before." An unexpected benefit of this improved relationship between residents and management is that residents have worked with management to protect CWS from external threats. As noted earlier, the main threat to the sanctuary over the past two decades has been local authorities, not local residents, trying to assert their authority over the resources of CWS (Aung et al., 2004). This is not an unusual circumstance for protected areas. In many protected areas, external threats, such as commercial timber or agricultural activities, can have greater impacts on PAs than local residents (Brosius and Russell, 2003; Wells and McShane, 2004) and can be harder for management to influence than the activities of local

**Table 3**

Comparison of resource use by households in 1999 and 2003, showing percentage of households that relied on sanctuary for livestock grazing, housepoles, and fuelwood and amount of fuelwood extracted.

	1999 (n = 510)%	2003 (n = 782)%
Grazing	67	40
Housepoles	80	60
Fuelwood	95	87
Fuelwood/month	1.41 carts	1.15 carts

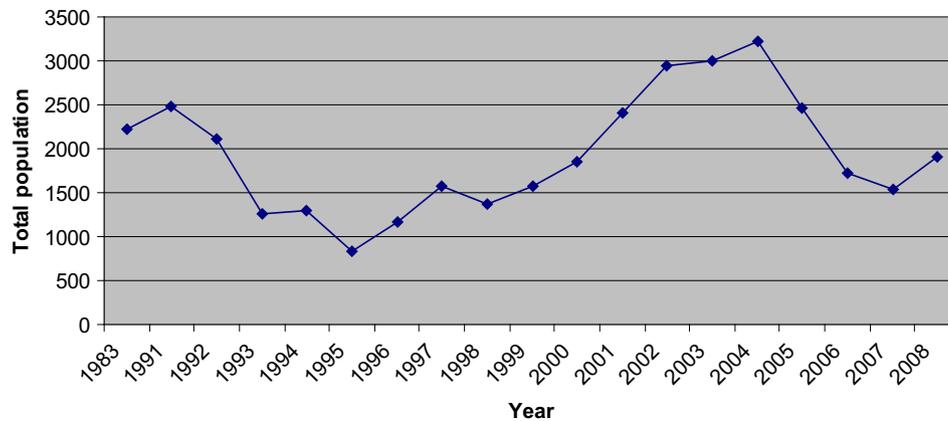


Fig. 2. Population of Eld's deer in Chatthin Wildlife Sanctuary from 1983 to 2008.

residents. In 2001, township authorities tried to convert parts of the buffer zone on the south side into agricultural land. They had brought two bulldozers into the area and were requiring local residents in the closest villages to contribute labor. The local villagers went to the CWS staff to report what was happening because they did not want the land converted for the benefit of higher-level authorities. The warden contacted the divisional commander, who ordered the township authorities to stop their activities in the buffer zone.

## 7. Conclusion

Resident attitudes and perceptions are important for management to understand how they can engage with local residents. This study demonstrates that residents' perceptions can be used by management as a starting point to improve park-people relationships through feasible and targeted interventions that are meaningful to local communities and their relationships with PAs. Understanding and acknowledging residents' perceptions is an important part of a process of engaging with local communities and building constructive relationships between residents and management.

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